WAR DEPARTMENT TECHNICAL MANUAL

TM 11-2413

This manual supersedes TM 11-2413, 15 June 1944.

HYDROGEN GENERATOR ML-303/TM AND HYDROGEN GENERATOR SET AN/TMQ-3

WAR DEPARTMENT • *APRIL 1945*

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United States Government Printing Office

Washington : 1945

WAR DEPARTMENT
WASHINGTON 25, D. C., 3 April 1945

TM 11–2413, Hydrogen Generator ML–303/TM and Hydrogen Generator Set AN/TMQ–3, is published for the information and guidance of all concerned.

[AG 300.7 (5 Sep 44)]

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Refer to FM 21–6 for explanation of distribution formula.

CONTENTS

DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW —1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut—Use axes, handaxes, machetes.
3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.
4. Explosives—Use firearms, grenades, TNT.
5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT—1. Smash—Hydrogen generators, manifold, Case CY–219/TMQ–3, punch.

2. Cut—Hose ML–81, generator cans, Case CY–219/TMQ–3, gaskets.
3. Burn—Case CY–219/TMQ–3.
4. Bend—Hydrogen generators, punch, manifold.
5. Bury or scatter—All or any of the above debris.

DESTROY EVERYTHING

SAFETY NOTICE

Hydrogen is a highly inflammable gas. Mixtures of hydrogen and air can be highly explosive. Never light a match or smoke near a site where hydrogen is generated. Remove all possible sources of flames and sparks.

This manual supersedes TM 11-2413, 15 June 1944

PART ONE

INTRODUCTION

Section I. DESCRIPTION

1. General

Hydrogen Generator ML-303/TM and Hydrogen Generator Set AN/TMQ-3 are used to generate hydrogen gas for the inflation of certain meteorological balloons. Hydrogen Generator ML-303/TM consists principally of an outlet tube and a generator body. Hydrogen Generator Set AN/TMQ-3 consists principally of four Hydrogen Generators ML-303/TM, a Manifold ML-344/TM, four lengths of Hose ML-81, and a carrying Case CY-219/TMQ-3. Hydrogen Generator ML-303/TM may be used separately or as a component of Hydrogen Generator Set AN/TMQ-3.

2. Application (figs. 1 and 2)

a. Both the hydrogen generator and the hydrogen generator set are used with Calcium Hydride Charges ML-304/TM and ML-305/TM. The hydrogen gas is produced by the reaction of calcium hydride and water.

b. Hydrogen Generator ML-303/TM is used with Calcium Hydride Charge ML-304/TM to produce the hydrogen gas necessary to inflate a 30-gram balloon. To inflate a 100-gram balloon, the generator is used with Calcium Hydride Charge ML-305/TM.

c. Hydrogen Generator Set AN/TMQ-3 is used with four Calcium Hydride Charges ML-305/TM or with Calcium Hydride Charges ML-305/TM in combination with Calcium Hydride Charges ML-304/TM to produce the hydrogen gas necessary to inflate 700-gram or 350-gram balloons.

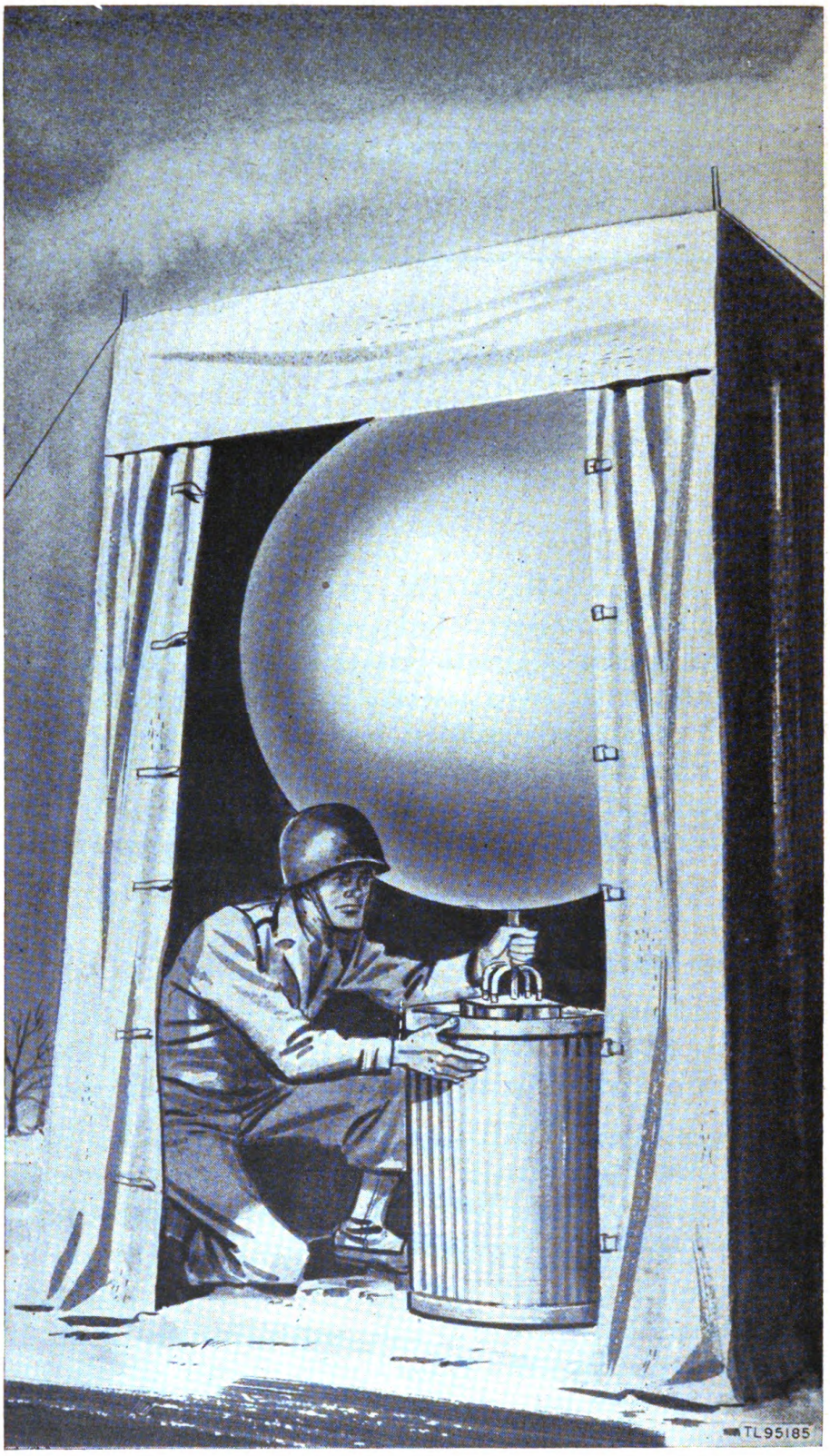

Figure. 1. Hydrogen Generator Set AN/TMQ–3 in operation.

3. Table of Major Components

a. Hydrogen Generator ML–303/TM (fig. 3).

Quan.	Components	Dimensions (in.)	
		Length	Diameter
1	Generator body	15½	5⅛
1	Outlet tube	3⅞	1¾
1	Gasket	——	1¾
1	Punch	3⅜	1⅝

b. Hydrogen Generator Set AN/TMQ–3 (fig. 4).

Quan.	Components	Dimensions (in.)				Volume (cu. ft.)	Weight (lb.)
		Length	Width	Height	Diameter		
4	Hydrogen Generator ML–303/TM (less punch).	19	..	..	5⅛	2.3	1.6
1	Manifold ML–334/TMQ–3.	10⁹⁄₁₀	10⁹⁄₁₀	11	..	..	2⁵⁄₁₆
4	Hose ML–81 (6-inch length).	6	..	..	½ (ID)	..	..
1	Case CY–219/TMQ–3	27	12	18	..	3½	32
1	Punch	3⅛	..	..	1⅝	..	
1	Running spare parts. 2 Hydrogen Generators ML–303/TM (less punch). 1 punch. 6 gaskets. 1 Hose ML–81 (5-foot length).						

Note. Running spare parts are for initial use only and are not to be requisitioned as a kit or group as shown in this list.

c. Calcium Hydride Charges. Calcium Hydride Charge ML–304/TM and Calcium Hydride Charge ML–305/TM are used with, but are not components of, Hydrogen Generator ML–303/TM and Hydrogen Generator Set AN/TMQ–3. The charges are furnished in accordance with allowance of expendable supplies prescribed by Army Service Forces Catalog Sig 4–1.

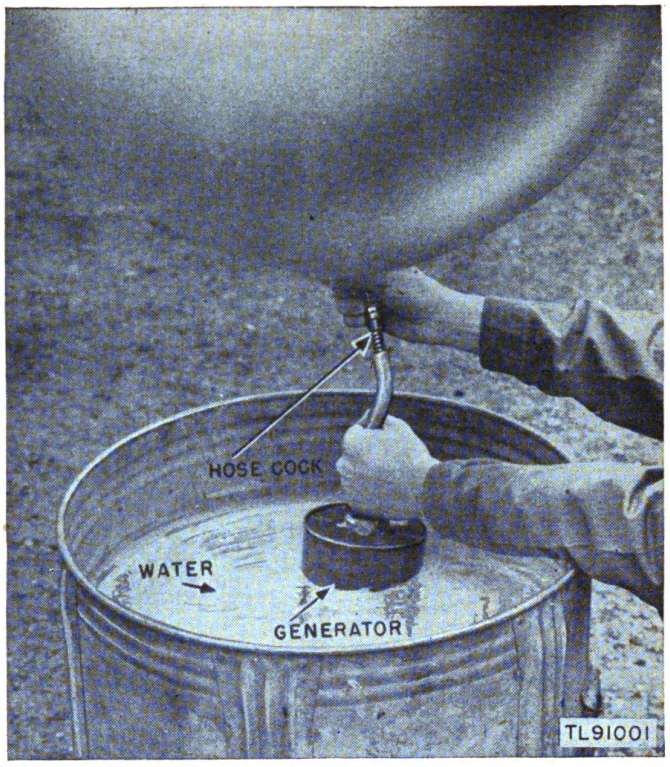

Figure 2. Hydrogen Generator ML–303/TM in operation.

4. Hydrogen Generator ML–303/TM (fig. 3)

a. GENERATOR BODY. The generator body is a cylindrical steel can. It is approximately 15½ inches long and 5⅛ inches in diameter. The top of the cylinder is provided with a threaded neck for attaching the outlet tube. The bottom of the generator is recessed and has a protruding center opening with male interrupted screw threads for attaching the calcium hydride charge. Eighteen holes, each approximately ⅜ inch in diameter, are arranged in a circle around the center opening (fig. 5). These openings serve as vents for the passage of water.

b. OUTLET TUBE. The outlet tube consists of both a metal screw cap, 1¾ inches in diameter, and an extended tube, ⅝ inch in diameter. The over-all length of the outlet tube is 3⅞ inches. A synthetic rubber gasket is fitted in the outlet tube cap to prevent any leakage of hydrogen through the base of the cap. The tip of the extended tube is corrugated to receive Hose ML–81.

c. PUNCH. The punch consists of a wooden handle, 1⅝ inches in diameter by 1¾ inches long, and a steel shaft, 3/16 inch in diameter by 1⅝ inch long, with a 45° point. It is used to punch out the knock-outs in the tops of the calcium hydride charge cans.

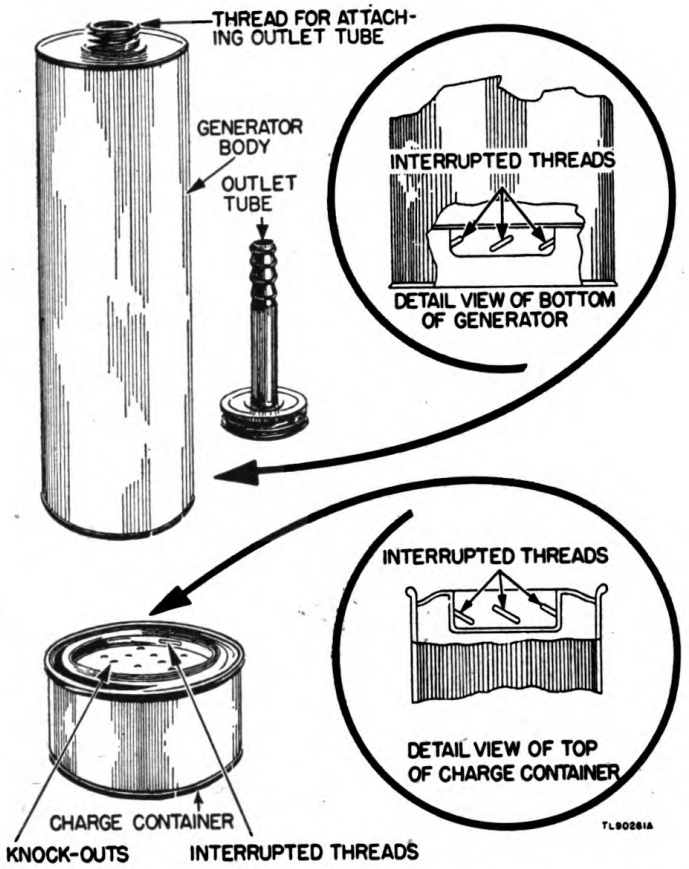

Figure 3. Hydrogen Generator ML–303/TM and Calcium Hydride Charge ML–304/TM.

5. Hydrogen Generator Set AN/TMQ – 3

Hydrogen Generator Set AN/TMQ–3 includes six Hydrogen Generators ML–303/TM (par. 4), Manifold ML–344/TMQ–3, Case CY–219/TMQ–3, and punches.

a. MANIFOLD ML–344/TMQ–3 (fig. 6). The manifold is a sheet-iron plate, $10\frac{9}{10}$ inches square and $\frac{1}{16}$ inch thick. A $1\frac{25}{32}$-inch hole is located in each corner to accommodate a Hydrogen Generator ML–303/TM. A steel tube, 1 inch inside diameter and 11 inches long, is welded at the center of, and perpendicular to, the plate. This steel tube is provided with four branches located 7 inches above the plate. Each branch is 1 inch long and $\frac{5}{8}$ inch outside diameter.

b. CASE CY–219/TMQ–3 (fig. 7). Case CY–219/TMQ–3 is designed to protect Hydrogen Generator Set AN/TMQ–3 against damage in transport. The case is constructed of $\frac{1}{2}$-inch plywood and is divided to hold the various components and running spare parts of the set. The case is composed of two sections clamped together by four trunk catches and is

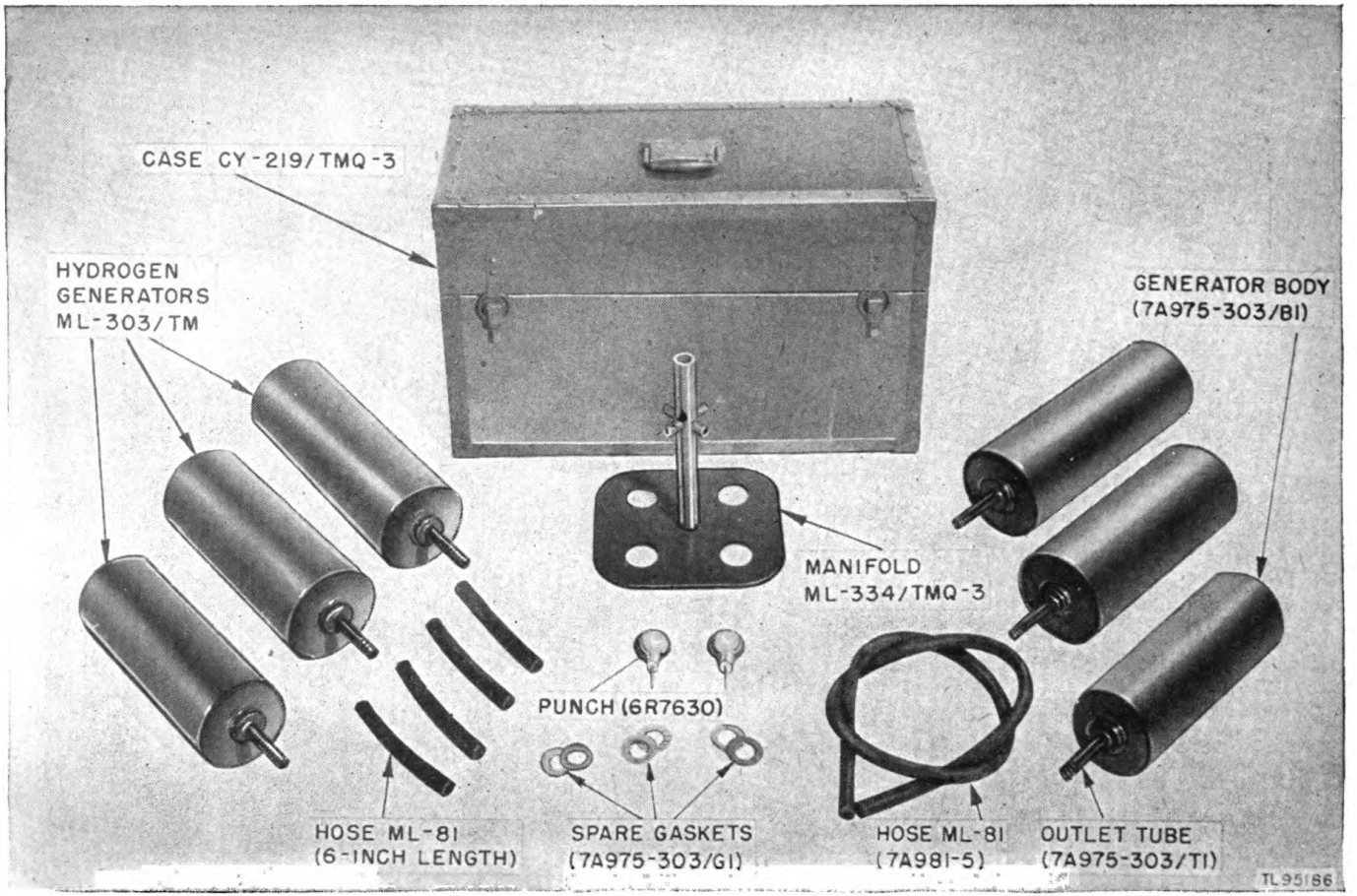

Figure 4. Hydrogen Generator Set AN/TMQ-3, components.

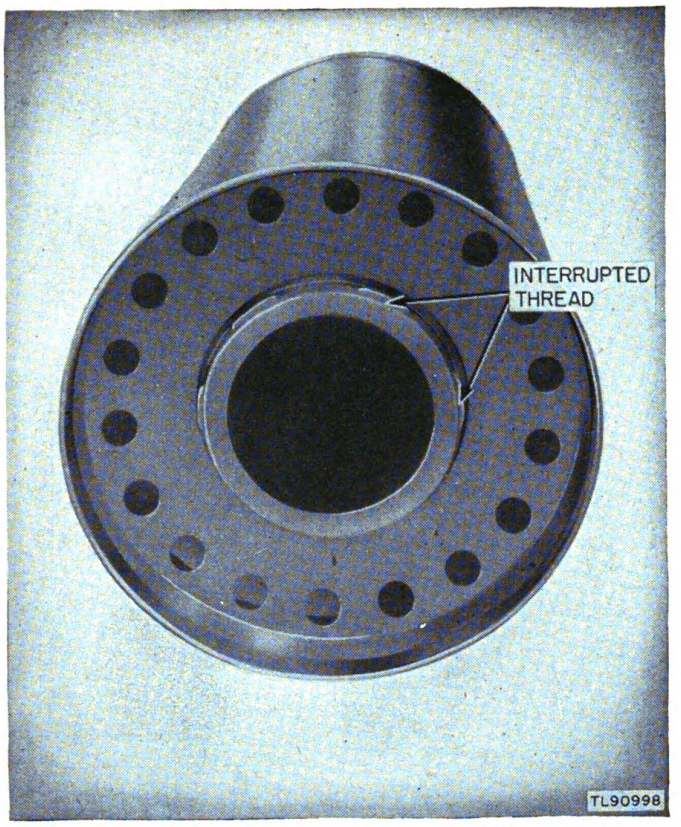

Figure 5. Hydrogen Generator ML–303/TM—bottom view.

equipped with a carrying handle on the cover. Neoprene weatherstripping is provided at the juncture of the two sections. All edges and corners of the case are protected by metal reinforcements. Case CY–219/TMQ–3 has a volume of 3½ cubic feet and weighs (including its contents) approximately 45 pounds.

c. PUNCH. The punch supplied with Hydrogen Generator Set AN/TMQ–3 is identical to the punch described in paragraph 4*c*.

6. Calcium Hydride Charge ML–304/TM (fig. 8)

Calcium Hydride Charge ML–304/TM contains between 13 and 14 ounces of calcium hydride. This quantity reacts with water to generate approximately 6 cubic feet of hydrogen for the inflation of a 30-gram balloon. The charge is sealed in an airtight metal can approximately 3¾ inches in diameter, 2½ inches high, and about 17 ounces in weight. The top of the charge can is recessed and is provided with a screw-fitting for attaching to the bottom of the generator body. The screw threads are interrupted so that only one-sixth of a turn is required to attach a charge

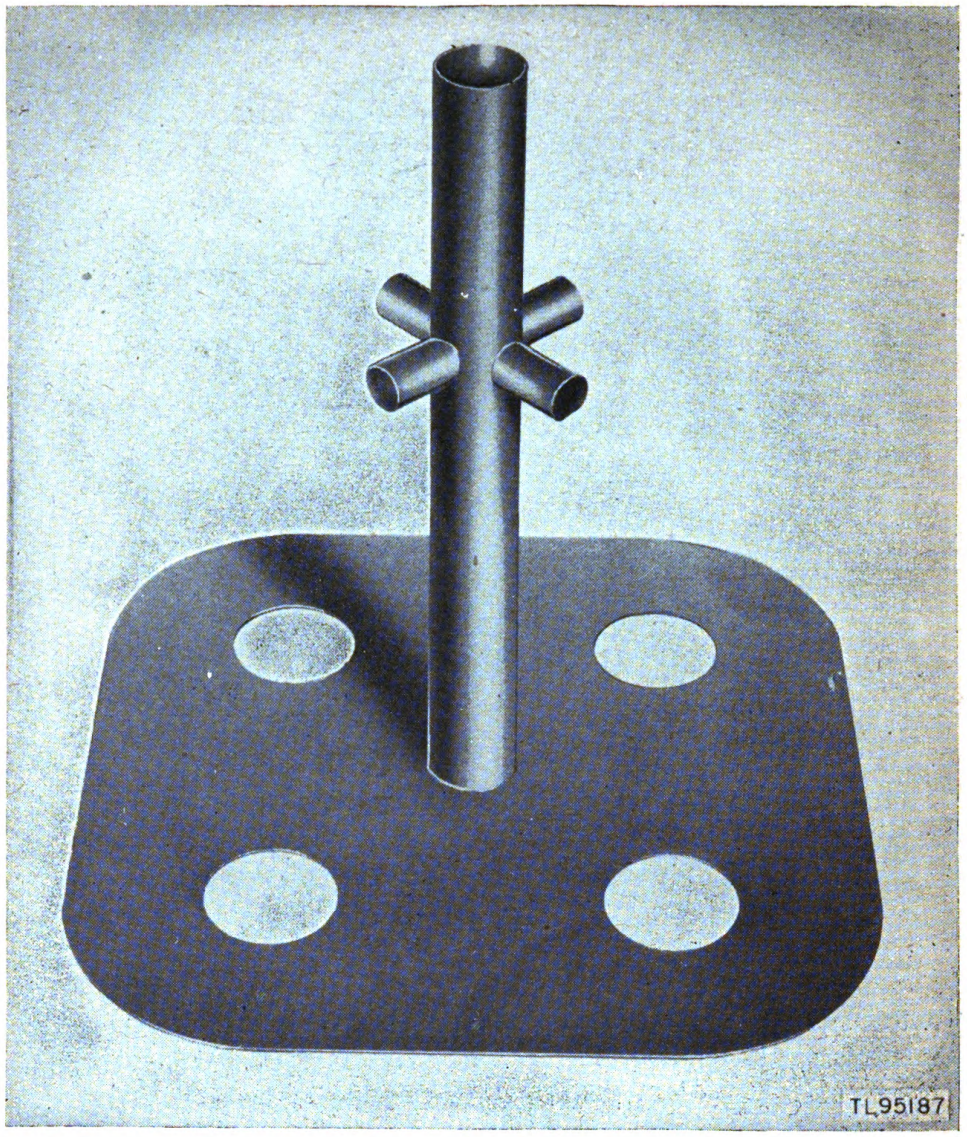

Figure 6. Manifold ML–344/TMQ–3.

to a generator. The top of the can is provided with 10 knock-out holes to expose the calcium hydride.

7. Calcium Hydride Charge ML–305/TM (fig. 8)

Calcium Hydride Charge ML–305/TM contains approximately 3½ pounds of calcium hydride. This quantity of the chemical reacts with water to generate approximately 24 cubic fet of hydrogen for the inflation of a 100-gram balloon. The charge is sealed in an airtight metal can 3¾ inches in diameter by 8 inches high. The over-all weight of Calcium Hydride Charge ML–305/TM is about 4 pounds. In all other details, Calcium Hydride Charge ML–305/TM is identical with Calcium Hydride Charge ML–304/TM.

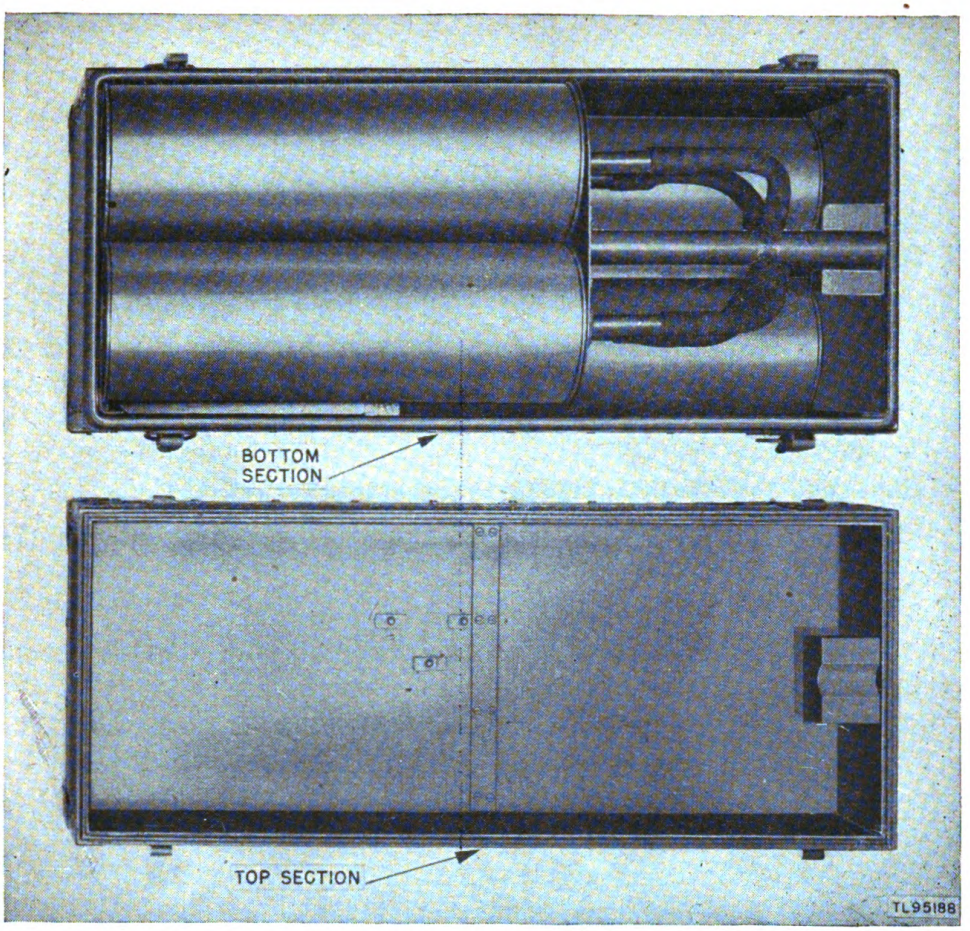

Figure 7. Case CY–219/TMQ–3, opened.

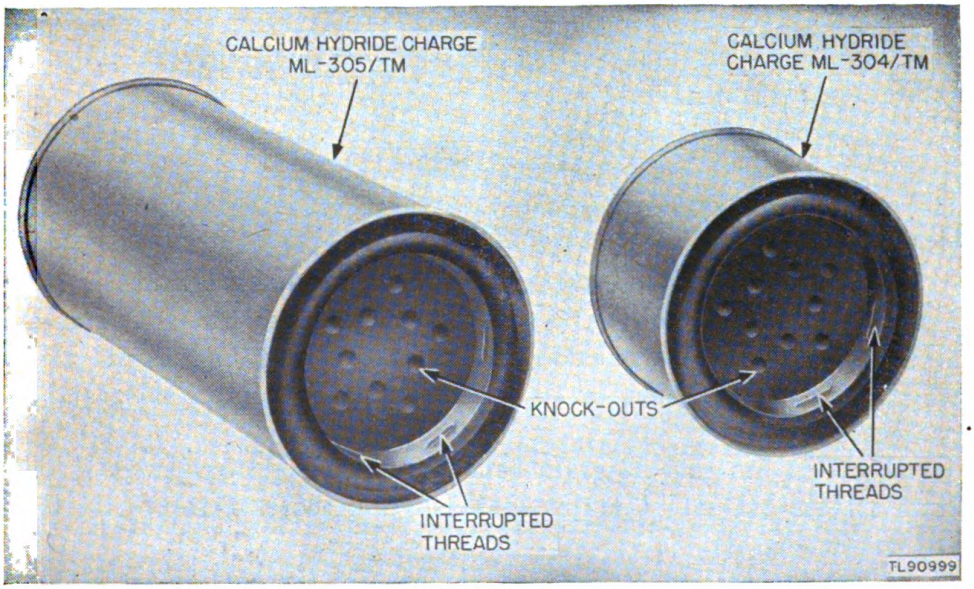

Figure 8. Calcium Hydride Charges ML–305 TM and ML–304/TM.

Section II. INSTALLATION AND ASSEMBLY

8. Siting

Hydrogen Generator ML–303/TM and Hydrogen Generator Set AN/TMQ–3 are used at or near the site where the balloon is to be released. If possible, generate the hydrogen near a water supply and near convenient drainage.

9. Unpacking and Checking Hydrogen Generator Set AN/TMQ–3

The crated weight of Hydrogen Generator Set AN/TMQ–3 is approximately 75 pounds.

a. Open the crate and remove the protective wrappings.

b. Unpack Case CY–219/TMQ–3 which contains the other components of the hydrogen generator set.

(1) Open the four trunk catches and remove the lid of the case.

(2) Lift out Manifold ML–344/TMQ–3 and the four Hydrogen Generators ML–303/TM attached to it. Four 6-inch lengths of Hose ML–81 are assembled between the manifold and the generators.

(3) Open the compartment in the bottom of the case, and check its contents. This compartment should contain two punches, one 5-foot length of Hose ML–81, six gaskets, and two outlet tubes for the two spare generator bodies. Remove these items as necessary.

(4) Check the two spare generator bodies in the bottom of the case.

10. Assembly

a. Hydrogen Generator ML–303/TM. (1) Screw the outlet tube tightly on the threaded opening in the top of the generator body.

(2) Attach one end of Hose ML–81 to the corrugated tip of the outlet tube. The other end of the hose is later connected to Cock ML–56 for the inflation of a 30-gram balloon, or to Cock ML–201–A for the inflation of a 100-gram balloon.

(3) In arctic climates, the water vapor in the generated hydrogen freezes and forms snow as it passes through Hose ML–81. The snow accumulates at the constriction in the balloon cock and forms a block which prevents the inflation of the balloon. To correct this condition, proceed as follows:

(*a*) When inflating 30-gram balloons, cut off approximately 2 inches from a Hose ML–81. Use this short length of hose instead of the standard length (fig. 2).

(*b*) When inflating 100-gram balloons, slip the balloon neck directly over the gas outlet tube instead of using Hose ML–81 and the balloon

cock. When the generation of hydrogen stops, pinch the neck of the balloon, and remove the balloon from the gas outlet tube. Slip the balloon over the balloon cock and weigh off.

b. Hydrogen Generator Set AN/TMQ–3 (fig. 9). Four hydrogen generators, the manifold, and the four 6-inch lengths of Hose ML–81 arrive fully assembled in the case. To reassemble, however, when necessary, proceed as follows:

(1) Place the screw necks of each of four generator bodies through the holes in the plate of Manifold ML–344/TMQ–3.

(2) Assemble the outlet tubes of the hydrogen generators on the screw necks so that the plate of the manifold is held between the generator body and the outlet tube of each generator. Tighten the outlet tube on the screw neck, and be sure that the outlet tube does not clamp against the plate.

(3) Slip one end of a 6-inch length of Hose ML–81 on the outlet tube of a generator and the other end on the branch of the manifold nearest the outlet tube. Repeat with the other three lengths of the hose and with the remaining three generators.

Caution: Be sure that there are no kinks or twists in the 6-inch lengths of Hose ML–81 to restrict the flow of gas into the balloons.

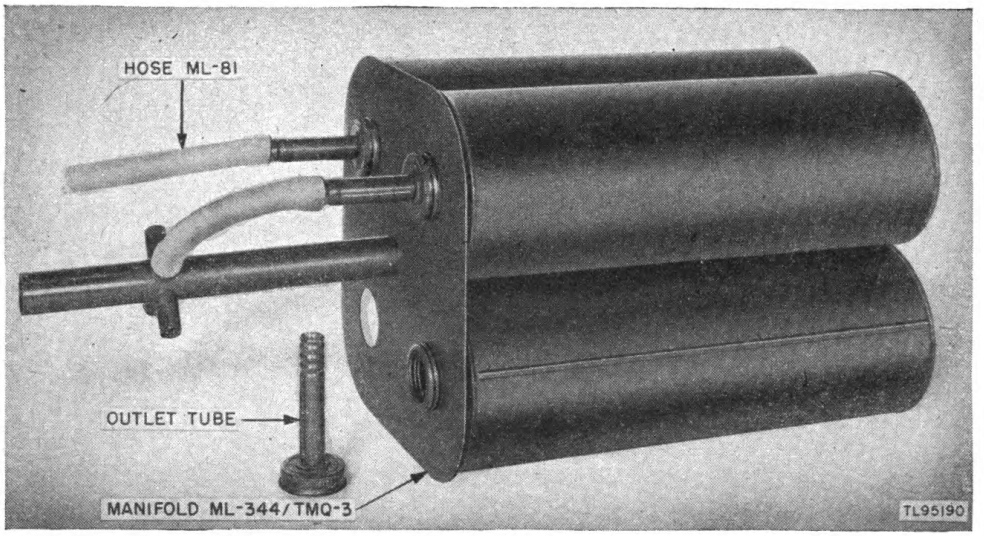

Figure 9. Assembling generators on manifold.

11. Repacking for Transport or Storage

To repack Hydrogen Generator Set AN/TMQ–3, proceed as follows:

a. Open the four trunk catches and remove the top section of the case.

b. Assemble four of the hydrogen generators and the four 6-inch lengths of Hose ML–81 on the manifold plate.

c. Replace the small parts in the compartment in the bottom of the case.

d. Replace the two spare generators in the bottom of the case.

e. Replace the manifold plate and the assembled four generators in the case so that the tube of the manifold rests in the bracket on the side of the case.

f. Replace the top section and fasten the four trunk catches (fig. 10). When replacing the top section, be sure the bracket in the top section fits over the bracket in the bottom section.

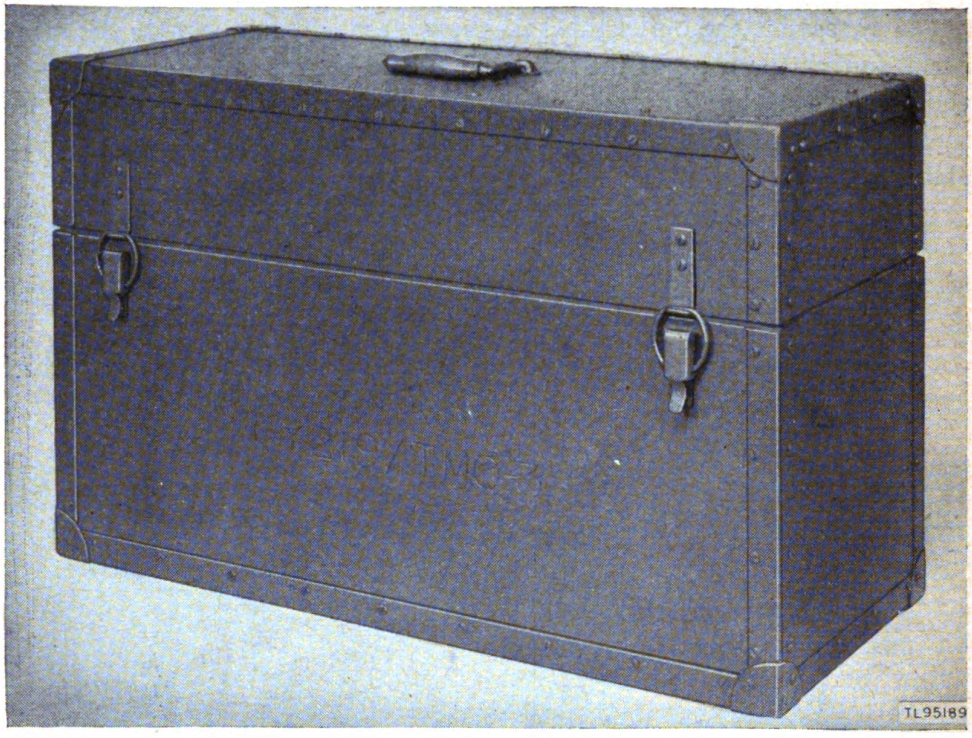

Figure 10. Case CY–219/TMQ–3 ready for transport.

PART TWO

OPERATING INSTRUCTIONS

Note. For information on destroying this equipment to prevent enemy use, see the destruction notice at the beginning of the manual.

Section III. PRELIMINARY PROCEDURE

12. Preparation of Hydrogen Generator ML–303/TM for Use

a. Obtain a container, preferably metal, at least 25 inches high and 10 inches in diameter. A 50-gallon drum or a 32-gallon GI can, Quartermaster Corps stock No. 42C1750, is a suitable container. A convenient stream or brook may be used as a water supply instead of the can of water.

b. Fill the container with either salt or fresh water to a depth of 22 inches. Use water as cool as possible so that the generated hydrogen gas will be cool.

c. Select the proper calcium hydride charge (par. 2*b*).

d. Attach the balloon to be inflated to the proper balloon cock (par. 10*a*(2)).

e. Punch out the knock-outs on the top of the proper charge can. Pressure sometimes accumulates within the charge container and carries out calcium hydride dust when the knock-outs are opened. Be careful that this dust is not blown into the eyes. Make sure that the knock-outs are punched out completely and that there is a space between the top of the can and the calcium hydride briquettes. Never punch out the knock-outs until the charge is to be used because the calcium hydride begins to deteriorate when it is exposed to the moisture in the air.

Note. If a blow-back condition occurs as a result of a too rapid generation, punch out fewer holes in subsequent inflations until the desired rate of generation is obtained.

f. Attach the calcium hydride charge to the bottom of the generator by engaging the interrupted threads (fig. 11).

13. Preparation of Hydrogen Generator Set AN/TMQ–3 for Use

a. Obtain a container and fill it with water to a depth of 21 inches. Either the 50-gallon or 32-gallon drum recommended for use with Hy-

drogen Generator ML–303/TM (par. 12*a*) is suitable for use with the hydrogen generator set.

b. Select the proper number of Calcium Hydride Charges ML–304/TM and ML–305/TM to obtain the desired amount of hydrogen. The amount of cubic feet to be generated depends upon the desired rate of ascent and the weight the balloon is to carry aloft.

To generate—	*Use—*
96 cubic feet of hydrogen.....	4 Calcium Hydride Charges ML–305/TM.
78 cubic feet of hydrogen.....	3 Calcium Hydride Charges ML–305/TM; 1 Calcium Hydride Charge ML–304/TM.
72 cubic feet of hydrogen.....	3 Calcium Hydride Charges ML–305/TM. (One generator is not used.)
60 cubic feet of hydrogen.....	2 Calcium Hydride Charges ML–305/TM; 2 Calcium Hydride Charges ML–304/TM.

Note. When generating 72 cubic feet of hydrogen, use the completely assembled set regardless of the number of charges used. The water that rises in the unused generator acts as an effective seal to prevent the escape of the hydrogen.

c. Punch out the knock-outs on the tops of the selected charge cans. Refer to paragraph 12*e* for precautions to be observed when preparing the charge cans.

d. Attach the calcium hydride charges to the bottom of the generators by engaging the interrupted threads (fig. 11).

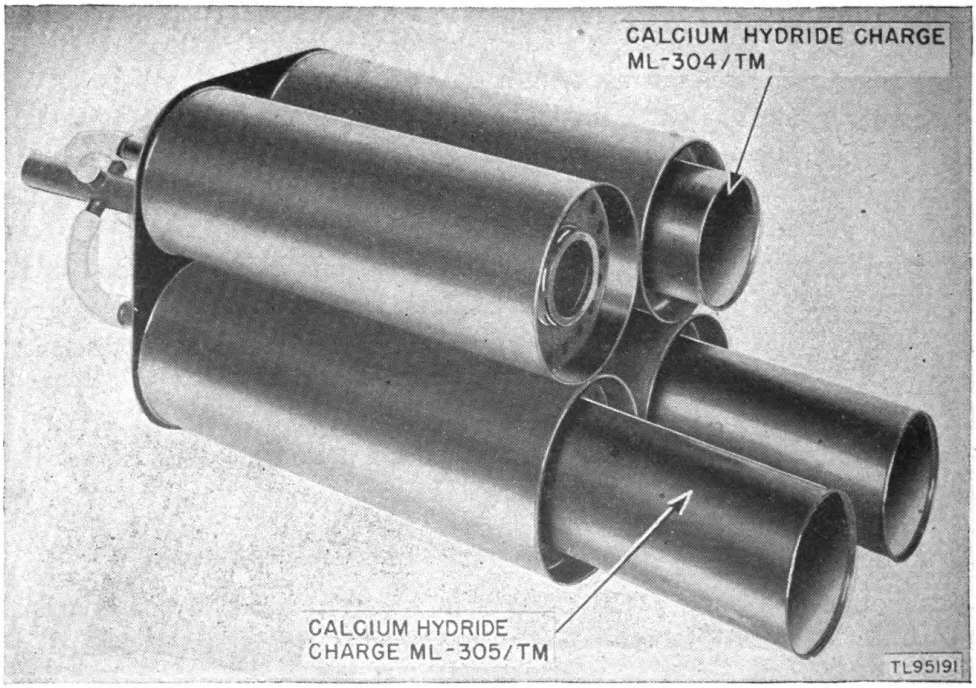

Figure 11. Attaching calcium hydride charges.

e. Slip the neck of the balloon over the outlet on Manifold ML–344/TMQ–3. The manifold outlet serves as an inflation nozzle. Tie the balloon securely on the outlet with twine if the balloon neck fits loosely.

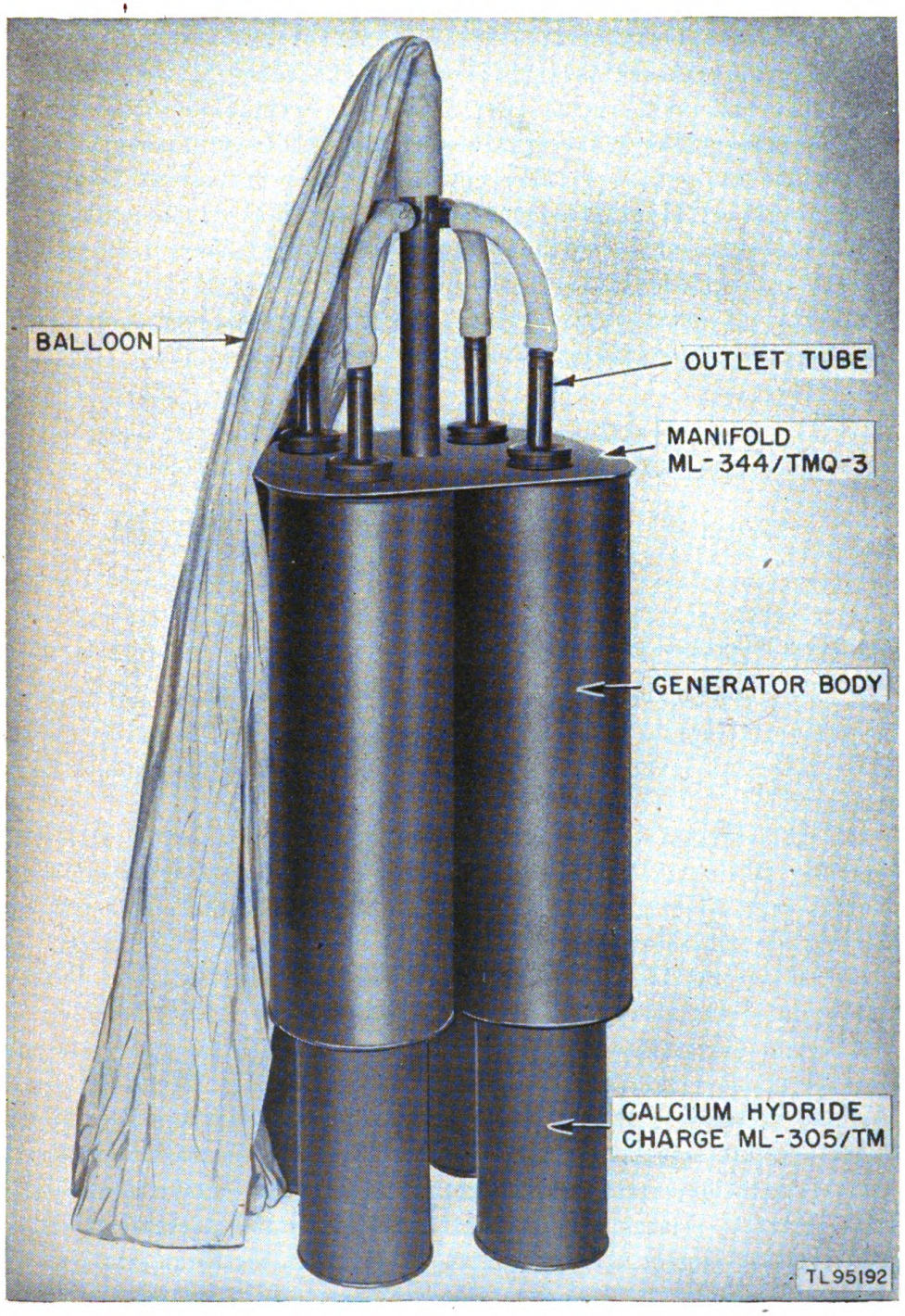

Figure 12. Part of Hydrogen Generator Set AN/TMQ–3 assembled, showing Calcium Hydride Charges ML–305 TM and a 350-gram balloon attached.

14. Precautions

a. Be sure that there is no constriction in the balloon neck while the balloon is being inflated.

b. Wear gloves when holding Hydrogen Generator ML–303/TM or Hydrogen Generator Set AN/TMQ–3. The nozzle may get very hot if a blow-back condition occurs.

c. Keep the stopcock passages of Cocks ML–56 and ML–201–A, when used, open and unobstructed (par. 10*a*(2)). Accumulations of dirt and other foreign matter in the openings of the cock cause a constriction of the passage and prevent the free flow of hydrogen through the cock. The low pressure of Hydrogen Generator ML–303/TM is not sufficient to blow the obstruction out of the cock or to inflate the balloon if the passage is badly constricted.

d. Keep all sparks, open flames, lighted cigarettes, and cigars away from the site where hydrogen is being generated.

Section IV. OPERATION OF EQUIPMENT AND USE OF ACCESSORIES

15. Using Hydrogen Generator ML–303/TM

a. Grasp the outlet nozzle of the generator (par. 14*d*), and immerse the generator rapidly in the supply of water to within 2 inches of the top of the generator body. A slight vibration indicates that hydrogen is being generated.

(1) If hydrogen escapes from the bottom of the generator, lower the generator so that the top of the generator body is below the water level. Do this only when gas escapes from the botom because completely immersing the generator may cause water to be blown into the balloon.

(2) When the blow-off stops, raise the generator body top about 2 inches out of the water.

b. Allow the generated hydrogen to flow through the generator and hose for about 3 seconds in order to remove all the air. When the generator and hose are free of all air, open the balloon cock and slip the end of the hose on the balloon cock (to which the balloon is already attached).

c. Move the generator assembly 2 or 3 inches up and down in the water. This agitation washes out chemical byproducts and presents a cooler, fresher water supply to the reaction. As a result, the temperature of the hydrogen is lowered, and the rate of generation is increased. If the rate at which the generation takes place is too rapid, decrease the amount of agitation. If the rate of generation is too slow, increase the amount of agitation.

d. If the procedure of *c* above does not result in a successful generation of hydrogen, discard the charge can *in water* and prepare a new charge. *Never leave a partly used charge exposed to the air.*

e. Continue the procedure described in *c* above until the vibration in the generator stops. The generation of hydrogen is now complete. The reaction time for Calcium Hydride Charge ML–304/TM is approximately 6 minutes. The time for Calcium Hydride Charge ML–305/TM is from 17 to 20 minutes.

f. Turn the handle of the balloon cock to its closed position, and detach the hose.

g. Remove the generator from the water, and unscrew the calcium hydride charge can. Never lift the generator out of the water until the balloon is completely inflated and the cock has been closed.

h. Tie the balloon and weigh off (TM 11–2405). After inflation, the balloon contains an excess of hydrogen. Bleed off the excess hydrogen while weighing off.

i. Rinse the inside of the generator with water to remove the lime resulting from the reaction. The lime and other end products are not injurious to the skin or clothing.

j. After several generations of hydrogen, the water in the container will become full of lime. If this water is used in succeeding generations, the calcium hydroxide held in suspense in the water is often too concentrated to allow proper circulation of water to the charge. As a result, future generations of hydrogen will be slower. For best results, change the water after 8 to 10 generations when Calcium Hydride Charge ML–304/TM is used or after 3 generations when Calcium Hydride Charge ML–305/TM is used. If, however, water is difficult to obtain, a major portion of a used container of water may be recovered as follows:

(1) Allow the water to stand for about 2 hours. The calcium hydroxide residue from the generation cycle settles to the bottom of the container.

(2) Pour the clear water from the container into another receptacle, being careful not to stir up the sediment on the bottom.

(3) Dispose of the sludge.

16. Using Hydrogen Generator Set AN/TMQ–3

a. Grasp the outlet tube of Manifold ML–344/TMQ–3.

b. Lift the complete assembly and immerse it in the supply of water to within 2 inches of the top of the generator bodies. A vibration indicates that hydrogen is being generated.

c. Be sure that there is no constriction in the neck of the balloon. A constriction will restrict the flow of hydrogen into the balloon and will cause the hydrogen to escape from the bottom of the generators.

d. Move the assembly up and down to circulate fresh water through the chemicals. Refer to paragraph 15*c* and *d*.

e. When the vibration of the generator stops, the generation of hydrogen is complete.

f. Remove the balloon from the manifold outlet tube and tie off in the usual manner. If it is desired to weigh off the balloon, slip the balloon neck off the manifold outlet and slip it on Nozzle ML–196 (TM 11–2405). Weigh off and tie the balloon in the usual manner.

g. Rinse the inside of the generator bodies, the outlet tube and branches of the manifold, and the four lengths of hose with water to remove the lime which results from the reaction.

h. Change the water of generation after each generation of hydrogen. Proceed as in paragraph 15*j*(1), (2), and (3) if water is difficult to obtain.

17. Performance Check List for Hydrogen Generator ML–303/TM

	Item No.	Item	Action or condition	Normal indication	Corrective measure
Preparatory	1	Hydrogen Generator ML–303/TM.	Assemble outlet tube on generator body.	Tight seal; no leaks.	Par. 29.
	2	Hose ML–81	Connect Hose ML–81 to the generator.	No kinks, no twists.	Remove any constriction in the hose.
	3	Cocks ML–56 and ML–201-A.	Connect balloon to cock.	Stopcock passageway open and unobstructed.	TM 11–2405 and changes thereto.
	4	Calcium Hydride Charges ML–304/TM and ML–305/TM.	Punch out knockouts and attach charge to generator.	Calcium hydride briquettes exposed.	
Start	5	Hydrogen Generator ML–303/TM.	Place generator in water to within 2 inches of top of generator body.	Vibration indicates generation of hydrogen.	Par. 15*a*(1), (2).
	6	Hose ML–81	Connect the hose to the open cock.		
Equipment performance	7	Hydrogen Generator ML–303/TM.	Move generator up and down in water until vibration stops.	Balloon inflates.	Par. 15*d*.
Stop	8	Hydrogen Generator ML–303/TM.	Close cock, detach hose, remove generator from water.	Balloon is completely inflated.	

18. Performance Check List for Hydrogen Generator Set AN/TMQ–3

	Item No.	Item	Action or condition	Normal indication	Corrective measure
Preparatory	1	Generators and four lengths of hose assembled on manifold.	Remove the assembly from the case.		
	2	Calcium Hydride Charges ML–304/TM and ML–305/TM.	Select proper charges and punch out the knock-outs. Attach charges to generator.	Calcium hydride briquettes exposed.	
	3	Balloon	Slip balloon over outlet tube of manifold.	Balloon fits tightly with no constriction in neck.	Par. 13*e*.
Start	4	Hydrogen generator assembly.	Immerse entire assembly in water to within 2 inches of top of generator bodies.	Vibration indicates generation of hydrogen.	
Equipment performance	5	Hydrogen generator assembly.	Move the assembly up and down in the water until the vibration stops.	Balloon inflates.	Par. 15*d*.
Stop	6	Balloon	Tie off balloon and remove. Weigh off if desired.		
	7	Hydrogen generator asesmbly.	Remove the assembly from the water and rinse.		

PREVENTIVE MAINTENANCE

Section V. PREVENTIVE MAINTENANCE TECHNIQUES

19. Meaning of Preventive Maintenance

Preventive maintenance may be defined as a systematic series of operations performed periodically on equipment in order to maintain top efficiency in performance, to minimize unwanted interruptions in service, and to eliminate major break-downs. To appreciate the meaning of the term *preventive maintenance,* it is necessary to distinguish between preventive maintenance and trouble shooting and repair. The primary function of preventive maintenance is to prevent major break-downs and the consequent necessity of repair. In sharp contrast, the primary function of trouble shooting and repair is to locate and correct existing defects. The importance of preventive maintenance cannot be overemphasized. The usefulness of an entire meteorological system depends upon each piece of the equipment in the system being ready to operate at peak efficiency when needed. Consequently it is vitally important that operators and repairmen of meteorological equipment maintain their equipment properly.

Note. The operations in section VI are considered first and second echelon (organization operators and repairmen) maintenance.

20. Description of Preventive Maintenance Techniques

a. Most of the parts of meteorological equipment require routine preventive maintenance. Those requiring maintenance differ in the amount and kind required. The six basic maintenance operations to be performed by maintenance personnel are as follows: FEEL, INSPECT, TIGHTEN, CLEAN, ADJUST, and LUBRICATE. The following lettering system has been adopted for the six operations:

F—Feel
I —Inspect
T—Tighten
C—Clean
A—Adjust
L—Lubricate

b. The first two operations establish the need for the other four. The selection of operations is based on a knowledge of field requirements. Field use without continuous performance of necessary tightening, cleaning, and lubricating will result in most equipment becoming operationally erratic, undependable, and subject to break-down when it is most needed.

c. Cleaning and inspecting are the only operations in the FITCAL system of preventive maintenance which are performed on Hydrogen Generator ML–303/TM and on Hydrogen Generator Set AN/TMQ–3. Section VI contains all instructional material on the maintenance of the individual parts.

Section VI. PREVENTIVE MAINTENANCE ITEMS

21. Common Materials

Water and a dry cloth are the only materials required when performing preventive maintenance on these equipments.

22. Preventive Maintenance Check List

The following preventive maintenance check list shows a suggested schedule for performing maintenance. More frequent scheduling of operations due to unusual operating conditions is left to the discretion of the person in charge. All operations are considered first echelon.

Item No.	Description	Operation	When performed
1	Hydrogen Generator ML–303/TM (par. 23*b* and *c*).	IC	Daily
2	Manifold ML–344/TM (par. 23*b* and *c*).	IC	Daily
3	Hose ML–81 (par. 23*b* and *c*).	IC	Daily
4	Cocks ML–56 and ML–201-A (par. 23*c*, Note.)	IC	Daily

F	I	T	C	A	L
Feel	Inspect	Tighten	Clean	Adjust	Lubricate

23. Preventive Maintenance of Hydrogen Generator ML–303/TM and Hydrogen Generator Set AN/TMQ – 3

a. GENERAL. The byproduct of the reaction between calcium hydride and water is calcium hydroxide in solution, in suspension, or as a precipi-

tate which settles to the bottom of the water supply. This byproduct is harmless. Calcium hydroxide when exposed to the air reacts with the carbon dioxide of the air to form calcium carbonate which is very hard. If this calcium carbonate is allowed to accumulate and dry on the equipment, it clogs in the various openings and prevents the proper functioning of the equipment. Preventive maintenance techniques of inspection (I) and cleaning (C) are therefore necessary.

b. INSPECTION (I). Examine all passages through which the hydrogen must flow, and be certain that they are not clogged with residue. Check the outlet tube of the generator, Hose ML–81, and Manifold ML–344/TMQ–3. Check the perforated holes in the bottom of the generator where the charge is attached and the holes in the baffle plate located inside the generator body.

c. CLEANING (C). Rinse the equipment with water to wash out any residue which has accumulated. Dry with a clean cloth. Use a stick or long rod to remove lime or dirt that has caked inside the manifold tube or branches. Then rinse with water.

Note. Detailed instructions on the inspection and cleaning of Cocks ML–56 and ML–201–A are given in TM 11-2405 and changes thereto.

Section VII. LUBRICATION

Note. No lubrication is required for Hydrogen Generator ML–303/TM or for Hydrogen Generator Set AN/TMQ–3.

Section VIII. MOISTUREPROOFING AND FUNGIPROOFING

Note. No moistureproofing and fungiproofing are required for Hydrogen Generator ML–303/TM or Hydrogen Generator Set AN/TMQ–3.

PART FOUR

AUXILIARY EQUIPMENT

(NOT USED)

REPAIR INSTRUCTIONS

Note. Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on WD AGO Form 468 (Unsatisfactory Equipment Report). For details, see paragraph 30. If Form 468 is not available, see TM 38–250. Failure or unsatisfactory performance of equipment used by Army Air Forces will be reported on Army Air Forces Form 54 (Unsatisfactory Report).

Section IX. THEORY OF EQUIPMENT

24. Design

a. The design and operation of both Hydrogen Generator ML–303/TM and Hydrogen Generator Set AN/TMQ–3 eliminate all danger to operating personnel from excessive pressures. Operating pressure does not exceed 15 inches of water; pressures in excess of this value are automatically released. Also no harmful byproducts result from the reaction of calcium hydride with water. The low weight, small size, and simplicity of operation make these equipments readily transportable and desirable for use with mobile units of the armed forces.

b. Both Hydrogen Generator ML–303/TM and Hydrogen Generator Set AN/TMQ–3 release gas in a very short time, thus eliminating the need to store hydrogen. The single hydrogen generator produces 6 cubic feet of hydrogen in 6 minutes and 24 cubic feet in 17 to 20 minutes. The set generates 96 cubic feet of hydrogen in 20 minutes. With the hydrogen generator set, the generation cycle can be repeated every 30 or 40 minutes; this allows time to generate the gas, change the water, and prepare charges for the next generation.

25. Functioning

a. Hydrogen Generator ML–303/TM (fig. 13). When the generator is placed in water, the water enters the generator body through holes in the bottom baffle plate and reacts with the exposed calcium hydride briquettes attached to the bottom of the generator. The hydrogen gas bubbles rise through the water and pass through the outlet tube to the balloon. The outlet tube provides a means of attaching the hose. The water in the can serves as a seal to prevent the escape of hydrogen from

the bottom of the generator. The baffle plate in the top of the generator body prevents water from being blown out of the outlet tube with the hydrogen. During a blow-back condition, immersing the generator body increases the height of the water column and, therefore, the pressure opposing the blow back.

b. Hydrogen Generator Set AN/TMQ–3. In the operation of the hydrogen generator set, the gas is led from four generators to a common outlet which also serves as a balloon cock.

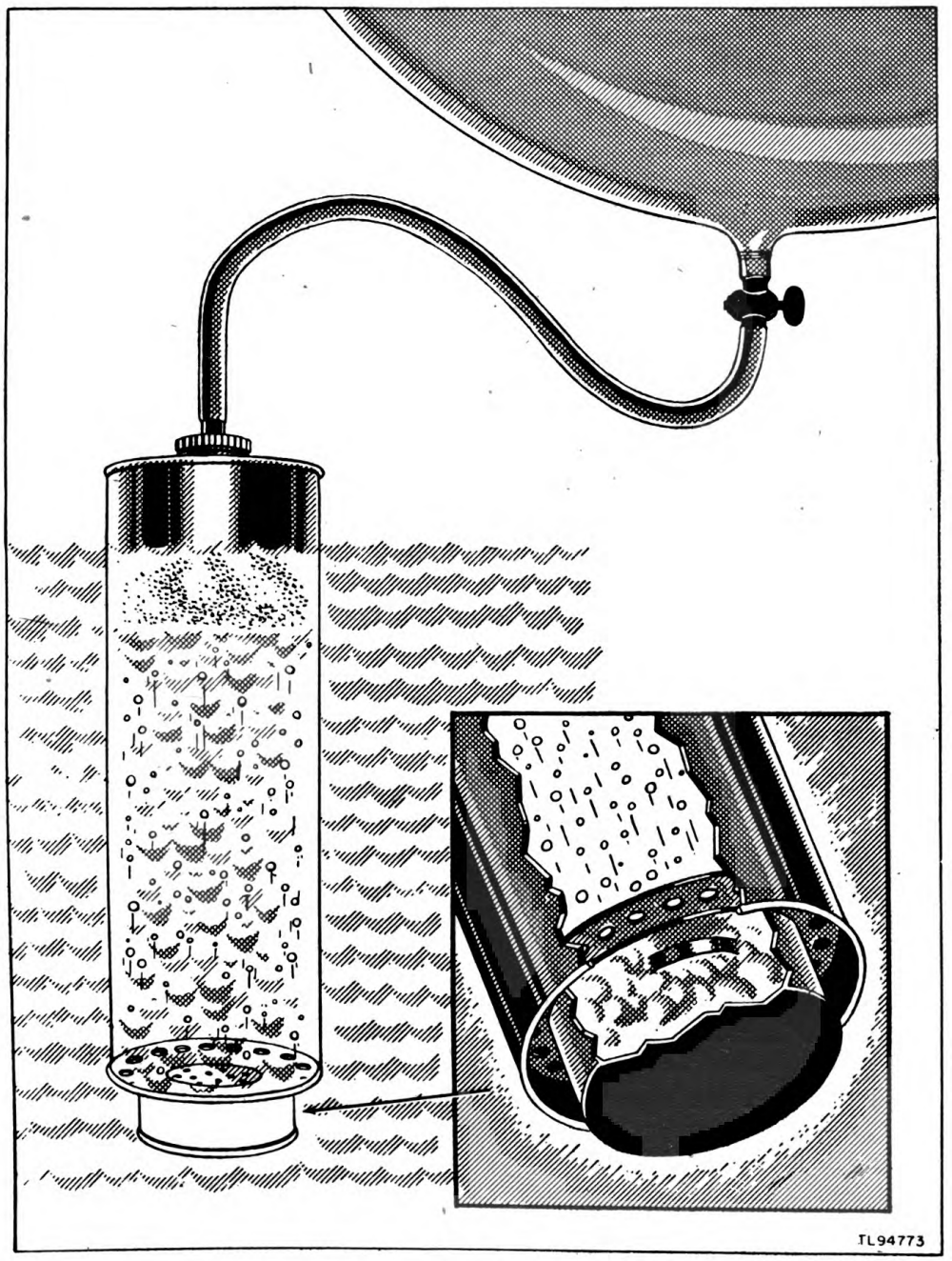

Figure 13. Functioning of hydrogen generator.

Section X. REPAIR

26. Trouble-shooting Chart

Trouble	What to do	Corrective action	Performance check
Generator leaks.	Cap outlet tube and immerse in water.	Replace gasket or any other part that leaks. Solder leaks in metal or seams.	No continuous flow of air bubbles rise through the water when generator is immersed completely.
No generation of hydrogen.	Determine if all knockouts in charge can are punched out completely.	Punch out all knockouts completely, or Discard charge can in water and replace with a new one.	Hydrogen is generated in proper length of time.
Hydrogen escapes from bottom of generator.	1. Examine the balloon neck and hose for constrictions. 2. Inspect the stopcock passages of Cocks ML–56 and ML–201–A and generators. 3. Check to see that the stopcock is open.	1. Untwist and remove all kinks from balloon neck and hose. 2. Disassemble the cock. Clean and wash all passages. 3. Open the stopcock fully.	Hydrogen gas does not escape from the bottom of the generator.
Too slow a generation of hydrogen gas.	Examine water supply.	1. Secure a fresh water supply. 2. Increase agitation of generator.	Increased generation of hydrogen.
Too rapid a generation of hydrogen.	Determine the number of knock-outs punched out in each charge can.	1. Decrease the number of knockouts opened. 2. Decrease the amount of agitation.	Decreased generation of hydrogen.

27. General Repair

In general, neither Hydrogen Generator ML–303/TM nor Hydrogen Generator Set AN/TMQ–3 require extensive repair. If a metal or rubber part is cut, dented, or otherwise badly damaged, order a new one.

28. Replacing Gasket

If the synthetic rubber gasket in the outlet tube is damaged, remove the gasket and replace it with a new one.

29. Repair of Leaks

a. CHECK FOR LEAKS. Occasionally check to be sure that the generator does not leak. Proceed as follows:

(1) *Hydrogen Generator ML–303/TM.* Cap the outlet tube of the generator and immerse the generator in water so that the air is trapped within the generator body. Leaks are evidenced by streams of air bubbles rising through the water.

(2) *Hydrogen Generator Set AN/TMQ–3.* Cap the outlet tube of Manifold ML–344/TMQ–3 and proceed as in *a* above.

b. REPAIR. (1) When the leak is caused by a damaged gasket, refer to paragraph 28.

(2) Solder open seams and small holes. When the leaks are caused by a large hole, solder a piece of sheet metal over the hole.

Section XI. ADJUSTMENTS

30. War Department Unsatisfactory Equipment Report

a. When trouble occurs more often than repair personnel consider normal, fill out War Department Unsatisfactory Equipment Report (WD AGO Form 468) and forward it in duplicate through channels to the Office of the Chief Signal Officer, Washington 25, D. C. Refer to TM 38–250 for complete instructions on the handling of this report.

b. Figure 14 is a sample filled-out Form 468.

WAR DEPARTMENT

UNSATISFACTORY EQUIPMENT REPORT

FOR (Technical service) Signal Corps — MATERIEL (Station) — DATE 22 November 1944

FROM (Organization) 00 Field Artillery Observation Battalion

TO (Next superior headquarters) 00 XI Corps — (Station) A.P.O. 000 — (Technical service) New York City

COMPLETE MAJOR ITEM

NOMENCLATURE: Hydrogen Generator ML-303/TM — TYPE: Ground, transportable

MODEL: — MANUFACTURER: American Can Co.

U. S. A. REG. NO.: Order No 299-Day-4526 — SERIAL NO.: — DATE RECEIVED: 14 November 1944

EQUIPMENT WITH WHICH USED (IF APPLICABLE): Balloons ML-50, ML-51

NOMENCLATURE OF DEFECTIVE COMPONENT

PART NO: S.C. Stock no. 7A975-303/TM — TYPE: Outlet Tube

MANUFACTURER: American Can Co. — DATE INSTALLED: 15 November 1944

LENGTH OF SERVICE

DATE OF INITIAL TROUBLE: 18 November 1944

TOTAL TIME INSTALLED: YEARS — MONTHS — DAYS: 3 days

TOTAL PERIOD OF OPERATION BEFORE FAILURE (FILL IN WHERE APPLICABLE): YEARS — MONTHS — DAYS — HOURS: 6 hours — MILES — ROUNDS

DESCRIPTION OF TROUBLE AND PROBABLE CAUSE

GIVE TYPE OF FAILURE, MECHANICAL, ELECTRICAL, WORKMANSHIP, MATERIAL, DESIGN

Leak at joint between tube and tube caps

UNUSUAL SERVICE CONDITIONS

GIVE BRIEF DESCRIPTION

TRAINING OR SKILL OF USING PERSONNEL (CHECK ONE): POOR — FAIR — GOOD ✓

DESCRIPTION OF ANY REMEDIAL ACTION TAKEN

Replaced damaged outlet tube with new one

RECOMMENDATIONS

1ST IND.

OFFICE — STATION — DATE

TO CHIEF (Technical service) Signal Officer, Washington, 25, D.C.

NAME — STATION — RANK

ORIGINATING OFFICER

SIGNATURE: John James

NAME: JOHN JAMES

RANK AND TITLE: Capt Field Artillery

ORGANIZATION: 00 Field Artillery Observation Battalion

INSTRUCTIONS

1. It is imperative that the Chief of Technical Service concerned be advised at the earliest practical moment of any constructional, design, or operational defect in material. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data.

2. This form will be used for reporting manufacturing, design or operational defects in material with a view to improving and correcting such defects, and for use in recommending modifications of material.

3. This form will not be used for reporting failures, isolated material defects or malfunctions of material resulting from fair-wear-and-tear or accidental damage nor for the replacement, repair, or the issue of parts and equipment. It does not replace currently authorized operational or performance records.

4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (Change No 3).

5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches or other illustrative material are highly desirable.

6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means.

7. This form will be made out by using or service organizations and forwarded in duplicate through command channels to the chief of technical service. The office of the chief of technical service receiving the report will forward an information copy to the Commanding General, Army Ground Forces or Army Air Forces, whichever is applicable, and to the Commanding General, Army Service Forces.

8. Necessity for using this form will be determined by the using or service troops.

W. D., A. G. O. FORM No. 468 (December 1943)

TL95193

Figure 14. WD AGO Form 468 with sample entries.

APPENDIX I

MAINTENANCE PARTS LIST

For information on maintenance parts, see appropriate sections of Army Service Forces Signal Supply Catalogs SIG–8 ML–303/TM and SIG–8 AN/TMQ–3, Higher Echelon Spare Parts. No SIG–7's will be prepared. Also see section of Army Service Forces Signal Supply Catalog SIG 10–900.1.

APPENDIX II

REFERENCES

Other technical publications:

TM 11–2405 and changes thereto.
TM 38–250.

Forms:

WD AGO Form 468 (Unsatisfactory Equipment Report).
AAF Form 54 (Unsatisfactory Report).

☆ U. S. GOVERNMENT PRINTING OFFICE; 1945—628027—TM-35